A behavioural model for the adoption of soil conservation practices

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1. Abstract

This paper tests a socio-psychological model (the theory of planned behaviour) to explain farmers' conservation decisions with respect to soil conservation. Socio-psychological constructs and conservation behaviour are assessed by means of a survey in Belgium. Results suggest that (a) the modified TPB is a good model to study and explain farmers' environmental behaviour and (b) the main reason for the low adoption rate of soil conservation practices in Belgium is a negative attitude towards these practices and not perceived social pressure, perceived difficulty of perceived lack of control. The paper ends by illustrating its immediate use in the severe enhancement of the cost-effectiveness of current extension efforts

2. Introduction

In European agriculture, growing sustainability concerns – partly invoked by the growing number of non-agricultural households migrating into rural areas – urges, since the late 1980s, governments, producers, scientists and consultants to take actions towards a more environmentally and socially sustainable way of farming. One of the main problems agriculture is facing is that of soil erosion and its associated on-site and off-site effects (see e.g. Pimentel, who ranks soil erosion as the second only to population growth main environmental threat, thus even before climate change (Pimentel, 2006)). On-site effects are mostly economic and refer to the damage to young plants and to the loss of the fertile top layer (see e.g. Favis-Mortlock, 2005). Off-site effects include muddy floods (see e.g. Boardman et al., 2006), soil and surface water contamination and economic clean-up costs for roads and streams (see e.g. Verstraeten et al., 2006a, b; Rekolainen et al., 2006).

Since soil erosion is an example of non-point source pollution, it is not possible to link pollution to polluter. In such cases, implementation at farm-level of best management practices (BMP) that conserve the soil is the most efficient way to inhibit the off-site damage. However, and contrary to developing countries, the main driver for soil conservation in developed countries is the desire to limit the off-site effects. As a result, farmers' demand for such practices is low. In Belgium – as in many EU countries – there are three kinds of approaches undertaken by governments to encourage the use of BMP. First, command and control is used on very erosion prone parcels, enforcing the farmers to use at least one conservation practice in order to receive full payment. Second, farmers that want to go beyond these cross-compliance measures can install agri-environmental practices in return for a subsidy. Third, governments, extension and science try to encourage voluntary, not subsidized adoption of BMP. All three have certain disadvantages. The success of command and control is very dependent on the degree of acceptance and thus compliance with the obligation. Monitoring costs are high and farmers feel deprived of their producer rights. Subsidies can cause budgetary problems since the costs can off-set the obtained benefit (see e.g. Napier et al., 1993; 2000). Furthermore redistribution issues might come up. Indeed, many studies found that a subsidy policy would be – to a large extent – a payment transfer to farmers who already adopted the respective BMP (see e.g. Kurkalova et al., 2006). Introduction of voluntary not subsidized practices seems to overcome these drawbacks but currently its cost-effectiveness is very limited. Indeed, despite many efforts by governments, extension agents and scientific action research, voluntary adoption is still limited.

Current extension efforts are conducted through the technology transfer approach, largely based on the diffusion of innovations model (Rogers, 2003). This asserts that pioneers and early adopters get their information through mass communication and that they differ from later adopters in terms of certain socio-demographic and personal factors. The innovations then diffuse through interpersonal contact between these pioneers and the later adopters. The main purpose of current extension is thus to get the information to these innovators through field demonstrations etc. The approach then assumes that the innovation will diffuse itself through the rest of the population. This process is supported by a subsidy policy for certain measures believed to impose costs to the adopters. However, observations point out that diffusion happens at a very low speed or even not at all. Furthermore, early adoption, stimulated by participation in action research projects tends to decrease once research projects end and/or subsidies are decreased or abolished. It seems that current extension efforts do not succeed in invoking a sustained behavioural change. This study tries to explain farmers' decisions to implement or not to implement BMP that conserve the soil. Its main use is to enhance the cost-effectiveness of extension, information, communication and demonstration efforts undertaken by governments, extension agents and action research projects. However also the other two approaches, as described above, can benefit from such a study. Insight into the factors influencing the use of soil conservation practices can increase acceptance of and compliance with command and control measures and may augment the success of a subsidy policy.

3. Methodology

Already for several decades, many studies have been carried out to investigate factors that could be associated with the use or non-use of soil conservation practices. An extensive literature review and meta-analysis revealed that that almost none of investigated factors applies universally. On the contrary, evidence across different studies is very mixed. On top of that, many models merely develop profiles of adopters and non-adopters, while goodness-of-fit measures expose a lack of explaining power of many models. For an extension policy to be cost-effective, an enhanced understanding of farmer decision making is needed. Our hypothesis is that the nature of these 'environmental innovations' calls for a different research approach, and thus extension approach, as compared to 'classic agricultural innovations'. While the latter are relatively easy, have clear benefits and pertain only to private benefits or loss (e.g. new seed variety, new cattle breed, new brand of tractor), the first are often complex, involve besides personal also environmental and social considerations and often fall beyond farmers' comfort zone (e.g. abandon the plough, implement buffer strips).

This paper applies a socio-psychological decision making model namely the theory of planned behavior (TPB) (Ajzen, 1991). According to the TPB, human actions is guided through three considerations (figure 1): the degree to which execution of the behavior is evaluated positively or negatively (attitude = A); the perceived social pressure to perform or not to perform the behavior (subjective norm = SN); and the perceived own capability to successfully perform the behavior (perceived behavioural control = PBC). Together they lead to a positive or negative intention towards the behavior. Given sufficient actual behavioural control (ABC), in terms of skills, knowledge, labour and capital, people will carry out their intentions.

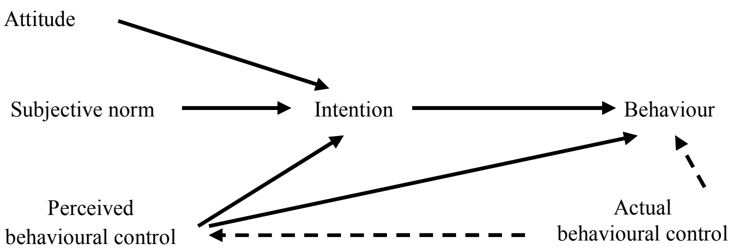

Figure 1 The Theory of Planned Behaviour (Ajzen, 1991)

Our approach reconciles these distinct approaches, by measuring qualitative information and variables in a quantitative way thereby acknowledging the subjective nature of the data while still harvesting the advantages of a quantitative approach (standardized, repeatable and interpretable for policy). The second objective of this paper is therefore also to investigate the usefulness of this type of approach in agricultural studies and to examine whether there are some modifications needed.

A survey was undertaken in 2005-2006 to empirically test the TPB[1]. For all farmers, behaviour was assessed using self-reports about the applied practices in the cultivation period following the period of data collection. For each practice a dichotomous variable was developed, being 1 when the practice is applied and being 0 otherwise. In this paper, results are presented for three practices: cover crops (as ex example of a 'classic innovation' that can inhibit soil erosion), buffer strips (as an example of an 'environmental innovation' with main feature that it exceed the border of farmers' comfort zone) and reduced tillage (as an example of an 'environmental innovation' that falls beyond farmers comfort zone and that is complex to apply). Assessment of the latent constructs (A, SN, PBC, I) was conducted in accordance with the extensive literature on these topics. Each of them was measured using a scale, comprised of several items, each item being a closed question to be answered on a 7-point scale[2].

[1] More details of the survey procedure, including a qualitative pilot-study can be consulted in one or more of our forthcoming publications, or on request

[2] Scales for the assessment of attitude, subjective norm, intention and perceived behavioural control are available on request

4. Results

4.1. Validity and reliability issues

When using scales comprising of several items, validity and reliability issues arise. Validity refers to the fact that a scale must indeed measure its supposed latent construct. Being in accordance with the relevant socio-psychological literature, validity is assured. Reliability refers to the notion that all items in a scale must measure the same construct. Reliability tests are conducted by means of Cronbach's alpha (Cronbach, 1951). While reliability for A, SN and I was shown to be sufficient, alpha values for PBC were too low. Factor analysis revealed that this scale clearly consisted of two subscales. This led us to the work of Trafimow et al. (2002) and Rhodes et al. (2003) who also found, in completely other domains, that the PBC construct actually comprised two sub-constructs namely perceived difficulty (PD) and perceived control (PC). Since PD refers to the perceived degree of complexity and PC to the degree of internal control, one can easily imagine cases in which one of both sub-construct is high while the other is low. Hence, for use in the agri-environmental domain, the TPB was modified, to include both PD and PC as separate constructs originated from PBC.

4.2. Analysis

To test the use of the TPB in the agri-environmental domain and in order to draw first conclusion concerning coil conservation in Belgium, the model was estimated using hierarchical regression analysis. First, behaviour is estimated using logistic regression analysis. Following the modified TPB, B is explained by intention, perceived difficulty and perceived control. Thus, the following equation is estimated:

$$B = \beta_1 I + \beta_2 PD + \beta_3 PC + \mu$$

When β_2 and β_3 are zero, farmers have full volitional control. Results indicate that for cover crops and reduced tillage, this is the case (table 1). When farmers are not applying these practices, it is because they do not have the intention to do so and not because of the lack of necessary skills, knowledge etc. For buffer strips, there is some influence of perceived difficulty: farmers who think it is very difficult to install buffer strips are less likely to do so, regardless of their intention. A look at the correlation coefficients and the goodness-of-fit measure suggests that the modified TPB is able to adequately explain farmers' behaviour.

Table 1 Results of the estimation of behaviour with intention (I), perceived difficulty (PD) and perceived control (PC) (n=138; significance is indicated with * = 0.10 %, ** = 0.05 % and * = 0.001 %)**

	r	Regression coefficient	Pseudo-R^2
Buffer strips			0.41
I	0.51***	3.44***	
PD	0.18*	0.56*	
PC	0.11	1.16	
Cover crops			0.33
I	0.57***	4.02***	
PD	0.18*	1.01	
PC	0.05	0.94	
Reduced tillage			0.31
I	0.48***	2.18***	
PD	0.26***	1.13	
PC	-0.02	0.86	

The next step in the hierarchical regression is to estimate intention. From the modified TPB, intention is explained by A, SN, PD and PC. Hence, the following equation is estimated:

$$I = \gamma_1 A + \gamma_2 SN + \gamma_3 PD + \gamma_4 PC + \mu$$

Results show that for all practices, A is the only significant explanatory variable for intention (table 2). Thus, when farmers do not have the intention to perform any of the studied practices, it is because they have a negative attitude towards this practice, not because of perceived social pressure or complexity issues.

Table 2 Results of the regression of I on attitude (A), subjective norm (SN), perceived difficulty (PD) and perceived control (PC) (n=138; significance is indicated with * = 0.10 %, ** = 0.05 % and * = 0.001 %)**

	r	Regression coefficient	R^2
Buffer strips			0.71
A	0.84***	0.87***	
SN	0.34***	0.07	
PD	0.60***	0.11	
PC	0.13	-0.04	
Cover crops			0.46
A	0.66***	0.98***	
SN	0.37***	0.14	
PD	0.24***	0.05	
PC	0.03	0.00	
Reduced tillage			0.59
A	0.76***	0.81***	
Sn	0.34***	0.04	
PD	0.46***	0.13	
PC	0.15	-0.02	

In sum, this paper proves that (a) the modified TPB is a good model to study and explain farmers' environmental behaviour and (b) the main reason for the low adoption rate of soil conservation practices in Belgium is a negative attitude towards these practices and not perceived social pressure, perceived difficulty of perceived lack of control. In further research, this model will be fine-tuned using background variables by means of structural equation modeling. For immediate use of results from this paper, belief-based measures, based on the expectancy-value model, for the attitude-construct were assessed. Indeed, attitude can be measured indirectly by means of behavioural beliefs i.e. beliefs about the likelihood of all outcomes farmers consider (b) and the evaluation of these outcomes (e):

$A \sim \sum b_i e_i$

In the survey, values b and e of each accessible outcome was assessed using a 7-point scale. Further analysis will reveal which beliefs and convictions are the reason behind farmers' negative attitude. This information will prove very valuable in targeting information, demonstration and communication towards farmers such that cost-effectiveness of extension efforts will increase.

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